MASTER OF SCIENCE
IN
METEOROLOGY AND PHYSICAL OCEANOGRAPHY

AEROSOL OPTICAL DEPTH RETRIEVAL BY NPS MODEL MODIFIED FOR SeaWiFS INPUT

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Using visible wavelength radiance data obtained from the spaceborne Sea-viewing Wide Field-of-view Sensor (SeaWiFS) during the Aerosol Characterization Experiment-Asia (ACE-Asia), an analysis of aerosol optical depth (AOD) was completed by modification to the NPS AOD Model. Cloud-free AOD estimates have been compiled in previous years from NOAA geosynchronous- and polar-orbiting satellite data and validated using surface sunphotometers. The objective of this thesis was to calibrate the linearized, single-scatter algorithm using estimated bi-directional surface reflectance and size-dependent phase function parameters. The intent of the study was to provide enhanced temporal AOD coverage in the littoral and open ocean environment with the addition of the orbiting SeaWiFS eight-channel radiometer to the established NOAA constellation of five-channel AVHRR-equipped satellites. Comparison to Aeronet ground stations provides *in-situ* ground truth. "Clean" ACE-Asia sky regions have a mode at SeaWiFS AOD around 0.25, while "dirty" dust plumes had a mode at AOD near 2.0, tailing beyond 4.0. Initial SeaWiFS AODs were about 20% higher than AVHRR in clean subregions and up to 100% higher in dirty subregions. Refined ozone and Rayleigh scatter parameters have reduced SeaWiFS this excess AOD by 6% to 12%. Red tide surface effects and multiple scatter atmospheric effects were present, complicating current assumptions.

The work has operational significance in providing more timely remote sensing data to military operators of electro-optical identification and targeting systems.

KEYWORDS: Sea-viewing Wide Field-of-view Sensor, SeaWiFS, Aerosol Optical Depth, AOD, Dust, ACE-ASIA, Sea of Japan, East China Sea, Yellow Sea

ASSESSING THE EFFECTS OF MODEL ERROR ON RADAR INFERRED EVAPORATIVE DUCTS

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A method for inferring evaporative duct refractivity profiles from radar clutter was introduced by *Rogers et al* (2000) called Refractivity from Clutter (RFC). Climatological data from three tactical ocean areas of interest were used to investigation the RFC method using a numerical simulation of an S-band radar. The magnitude of the error introduced by inferring a neutrally equivalent refractive profile from one parameter (radar clutter) was compared against the traditional bulk method which calculates the profile based on environmental measurements. A benchmark for the simulated RFC error was determined by applying measurement errors to the simulated environment and by then calculating refractive profiles using the bulk

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method. Results of the simulation show that the error introduced by the RFC method is comparable to the error caused by measurement errors for the traditional method. The neutral equivalent profile inferred by RFC exhibited slightly increasing error with height and more than twice the error with frequency when applied to X-band propagation. Finally, a method for investigating tactical impacts of using refractive profiles against low flying anti-ship missiles was developed. Results show that the simulated RFC method determined the detection range of several hypothetical missiles within five percent of the actual predicted range.

KEYWORDS: Refractivity from Clutter (RFC), Radar Propagation, Evaporation Duct

AN APPLICATION OF LIDAR TO EXAMINE EROSION IN THE SOUTHERN MONTEREY BAY DURING THE 1997-98 EL NIÑO

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Light Detection and Ranging (LIDAR) was used in a Geographic Information System (GIS) to quantify coastal changes to beaches and dunes in the Southern Monterey Bay region and to qualitatively assess the erosional impact of large storms on coastal dune areas. LIDAR provides a rapid and accurate survey technique to measure topographic elevation. A LIDAR survey was performed in October 1997 and then a second survey in April 1998 to measure the erosion occurring during the 1997-1998 El Niño winter storm. Maximum dune erosion occurred in the vicinity of Fort Ord (13 m) and Marina (15 m), along with significant dune recession in Monterey and Sand City. Beach erosion was prevalent from Moss Landing to Monterey showing the seasonal beach loss. There was a large spatial variability all along the shoreline, with many numerous erosional "hot spots." From the profile data, the calculated volume loss from Monterey to Moss Landing (~22km) was 880,800 m^3, which was calculated by multiplying the dune top recession between the two surveys by the height of the dune from the toe to the dune top. From the cut fill calculation within ArcView total volume loss was calculated to be 2,470,000 m^3, which included both dune and beach erosion. LIDAR data provide a high-quality representation of the episodic erosion process in Southern Monterey Bay, and also offers useful environmental information to the warfighter in terms of detailed beach or landing zone characterizations.

KEYWORDS: Erosion, LIDAR, Sediment Transport, El Niño, Southern Monterey Bay

EXAMINATION OF THE 13 FEBRUARY 2001 EASTERN PACIFIC CYCLOGENESIS

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On 13 February 2001, an explosive cyclone made landfall in Southern California. This system was responsible for storm force winds and heavy precipitation in the Los Angeles area. This storm is interesting because it was handled poorly by the numerical models and developed in an unusual area.

Analysis of this storm revealed double circulation centers and multiple baroclinic zones. Due to weak static stability, air-sea fluxes were contributory in developing the baroclinic zone from which this cyclone originated as well as enhancing its development rate. Evidence suggests that the system may have had a warm core, similar to other intense extratropical cyclones.

The models did not properly forecast this system due to weak cold air advection over the Eastern Pacific Ocean and due to blending the subpolar and subtropical jets into a single feature. Data assimilation is suspected to have played a role in the mishandling of these key features.

KEYWORDS: NOGAPS, COAMPS, Explosive Cyclogenesis, Maritime Cyclogenesis, Air-Sea Fluxes

VICARIOUS CALIBRATION OF SATELLITE RADIANCES USED IN AEROSOL OPTICAL DEPTH RETRIEVALS

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The feasibility of using the Naval Postgraduate School (NPS) Aerosol Model on an operational military satellite to retrieve Aerosol Optical Depths (AOD) was investigated. Prior to accomplishing this proof-of-concept, the satellite of interest required calibration of a number of its channels. Initially, a direct vicarious calibration against the Advanced Very High Resolution Radiometer (AVHRR) sensor aboard the National Oceanographic and Atmospheric Administration's (NOAA) N16 satellite was attempted. This proved to have qualitative value, but was not robust enough to accurately quantify the errors of the subject satellite's channels. A method using reflectance values was developed and proved sufficient to accomplish the calibration. AOD's were retrieved and compared from both the target satellite and AVHRR. The results indicate that the NPS Aerosol Model has great potential for characterizing atmospheric aerosols using this platform. Algorithms developed from this capability will directly aid theater commanders in mission planning and execution.

KEYWORDS: Satellite Remote Sensing, Atmospheric Aerosol, Cobra Brass, Calibration